

# 10.—The genus *Vermicella* (Serpentes, Elapidae) in Western Australia and the Northern Territory

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Manuscript accepted 21 February 1967; accepted 22 June 1967

## Abstract

The concept of *Vermicella* is enlarged so as to embrace all Australian "coral snakes" and "bandy-bandies", thus causing *Rhynchoelaps*, *Brachyurops* etc. to fall into synonymy. Six species (*annulata*, *bertholdi*, *calonotos*, *bimaculata*, *fasciolata* and *semifasciata*) are dealt with and an additional seven subspecies, three of which are new: *annulata snelli*, *bertholdi littoralis* and *semifasciata incincta*.

## Introduction

The seven species of Australian coral snakes and bandy-bandies were described between 1841 and 1884. In the same short period seven generic names were proposed for them, not counting the numerous genera, colubrid as well as elapid, in which authors wrongly placed them.

Boulenger (1896) brought some order to the group by reducing the number of genera to two, *Furina* and *Rhynchelaps*. But his choice of names for the genera was inept (as was his allocation of the species). As originally conceived (Duméril 1853: 517) *Furina* was composite, and only *F. diadema* (Schlegel) of its four included species was not a *nomen nudum*. Thus the designation by Jan (1859: 124) of *diadema* as type-species of *Furina* was well founded. This action (which incidentally made *Furina* an objective synonym of *Brachysoma* Fitzinger) was ignored by Günther (1863: 24) when he chose *F. bimaculata* as type-species of *Furina*. In this he was followed by Boulenger who included *bimaculata* in his concept of *Furina* but not *diadema*. The name of Boulenger's other genus was an emendation of the *nomen nudum* *Rhynchoelaps* Jan, which even its proposer had forgotten when describing its type-species, *bertholdi*, a few months later.

Recently, Kinghorn (1955) has split one of Boulenger's genera (*Rhynchelaps*) into three virtually monotypic genera, and Worrell (1960, 1961) has done likewise with the other. To show how little reliance can be placed on these "genera", Kinghorn put *approximans* in *Rhynchelaps* with *fasciolata*, rather than in *Brachyurops* with the other races of *semifasciata*. Similarly Worrell put *minima* in *Melwardia* with *calonotos*, rather than in *Rhynchoelaps* with the other races of *bertholdi*.

Despite some diversity in coloration and the degree to which they are modified for burrowing, these snakes clearly form a chain of closely related species. When they are brought together, the resultant genus *Vermicella* is no less homogeneous than other Australian genera of Elapidae.

In contrast to the past generic confusion, the species have generally presented workers with little difficulty. The morphological gaps between them are of a considerably higher order than those between the races of any species; and almost all taxa can be recognised on coloration alone. Next in importance for diagnosis are the ventrals, subcaudals and lateral head shields

(temporals, preocular, nasal and labials). The upper head shields (except in one instance for internasals) are of little value; they have been described mainly in order to refute the reliance placed on them by previous workers. The scutellation of the lower jaw is of even less value and has not been described here; details of lower labials, chin-shields etc. are available on request.

The present study is based mainly on specimens in the Western Australian Museum; their numbers are prefixed with R only. For the loan of specimens in the collection of the Northern Territory Administration, Alice Springs (numbers prefixed with NTM); in the South Australian Museum, Adelaide (SAM); National Museum, Melbourne (NM); Australian Museum Sydney (AM); and Queensland Museum, Brisbane (QM); I am indebted respectively to Messrs B. Hart, F. J. Mitchell, J. McNally, H. G. Cogger and J. T. Woods. I am grateful to Mrs. A. Neumann (Librarian, Western Australian Museum) for translating Sternfeld's description of *Rhynchelaps anomalus*.

## Genus *Vermicella* Günther

- Vermicella* Günther, 1858: 236. Type-species (by monotypy): *V. annulata* (Gray).  
*Homaloselaps* Jan, 1858: 518. Type-species (by monotypy): *Elaps occipitalis* Duméril, Bibron & Duméril [= *V. a. annulata*]. [*Nomen nudum*.]  
*Rhynchoelaps* Jan, 1858: 518. Type-species (by monotypy): *Elaps bertholdi* Jan. [*Nomen nudum*.]  
*Simoselaps* Jan, 1859: 123. Type-species (by monotypy): *Elaps bertholdi* Jan. [(?) *Nomen nudum*.]  
*Brachyurops* Günther, 1863: 21. Type-species (by monotypy): *B. semifasciata* Günther.  
*Neelaps* Günther, 1863: 24. Type-species (by monotypy): *N. calonotos* (Duméril, Bibron & Duméril).  
*Rhinelaps* Günther, 1872: 33. Type-species (by original designation): *R. fasciolatus* Günther.  
*Rhynchelaps* Boulenger, 1896: 361. Emendation of *Rhynchoelaps* Jan.  
*Hornea* Lucas & Frost, 1896: 150. Type-species (by monotypy): *H. pulchella* Lucas & Frost [= *V. fasciolata fasciata* Stirling & Zietz].  
*Melwardia* Worrell, 1960: 132. Type-species (by original designation): *M. minima* Worrell [= *V. bertholdi anomalus* (Sternfeld)].  
*Narophis* Worrell, 1961: 27. Type-species (by monotypy): *N. bimaculata* (Duméril, Bibron & Duméril).

**Diagnosis.**—Small short-tailed elapid snakes with 15 or 17 rows of smooth scales, divided anal and subcaudals, and more or less prominent snouts. Distinguished from *Aspidomorphus* and *Glyphodon* by smaller head (not wider than neck), more prominent snout (rostral extending back at least quarter way to frontal), shorter and less dentigerous maxillary, and smaller post-frontal. Distinguished from *Demansia* by having no "canthus rostralis", eye much smaller than its distance from mouth, supraocular much smaller than frontal, subcaudals fewer than 36, shorter and less dentigerous maxillary, and exclusion or near exclusion of frontals from orbit.

**Distribution.**—Australia between latitudes 12 and 38° S.

**Description.**—Body slender to moderately stout. Tail 4-16% of total length, relatively longer and slenderer in males than females. Snout moderately or greatly prolonged past mouth, its tip rounded or acute in profile.

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The nine colubroid upper head shields are only occasionally fused and seldom divided. Rostral always visible from above; its apex either rounded, obtusely angular or acute, and reaching back  $\frac{1}{4}$ - $\frac{3}{8}$  way to frontal. Internasals smaller than prefrontals and, except in one race of *annulata*, not normally fused to them. Prefrontal-internasal suture transverse or oblique (backwards to midline of head). Frontal much larger than supraoculars. Parietals varying from short and wide to long and narrow.

Nasal entire (semidivided in some races of *semifasciata*) and normally contacting preocular (except in *warro* and *fasciolata*). Postoculars 2, lower usually smaller and sometimes fused to an adjacent shield. Temporals basically 1 + 1 + 2, but fusion common (especially between primary and secondary); division rare (except in *warro*, where 2 + 2 + 3 is normal).

Upper labials normally 5 or 6, last longest, third and fourth entering orbit. Lower labials normally 7, fourth largest, last smallest. Chin-shields small, anterior pair contacting first three labials and occasionally fourth; posterior pair usually a little longer and narrower than anterior, completely or partly separated by azygous or paired scales, normally in broad contact with fourth labial and often narrowly with third.

Dorsal scales smooth, 15 or 17 rows, increasing (if at all) only on neck and reducing (if at all) immediately or a little before vent. Anal and all subcaudals normally divided (except in some races of *bertholdi*, which commonly have first few subcaudals entire).

Upper surface white, yellow or reddish, variously marked with black or dark brown. Common to all taxa is a dark blotch on nape, and to all but *warro* and some races of *bertholdi* a dark blotch on head (frontals, parietals, temporals, down to at least level of eyes). Many snakes have end of snout dark and body and tail crossed or encircled by numerous dark bands. Remaining taxa unbanded, including one with dark vertebral stripe.

#### Key to western taxa

- (1) Scale rows 15 ..... 2  
Scale rows 17 ..... 10
- (2) Body and tail banded ..... 3  
Body and tail not banded ..... 8
- (3) Bands black, usually encircling body; snout not upturned and not tipped with cutting edge ..... 4  
Bands dark brown, not reaching lower surface; snout upturned and tipped with cutting edge ..... *semifasciata roperi*
- (4) Dorsal ground colour white; nasal not lower than long; ventrals more than 240 ..... 5  
Dorsal ground colour yellow; nasal much lower than long; ventrals fewer than 140 ..... 6
- (5) Internasals fused to prefrontals ..... *annulata multifasciata*  
Internasals free ..... *annulata snelli*
- (6) Upper labials 6 (excluding primary temporal if it reaches lip); head blotch absent or small and ill-defined ..... 7  
Upper labials 5 (excluding primary temporal which reaches lip); head blotch large and sharply defined ..... *bertholdi anomala*

- (7) Occipital bar of black-edged, white-centred scales, ill-defined from head and nuchal blotches; nuchal blotch more than 4 scales long; dark lines along throat; primary temporal not reaching lip ..... *bertholdi bertholdi*  
Occipital bar white, sharply defined from head and nuchal blotches; nuchal blotch not more than 4 scales long; no lines along throat; primary temporal usually reaching lip ..... *bertholdi littoralis*
- (8) Primary temporal large and square, broadly contracting lip ..... *bertholdi anomala*  
Primary temporal low and oblong, distant from lip ..... 9
- (9) Vertebral stripe of black-edged white-centred scales; upper labials 6; ventrals fewer than 150 ..... *calonotos*  
No vertebral stripe; upper labials normally 5; ventrals more than 170 ..... *bimaculata*
- (10) Preocular widely separated from nasal, contacting frontal or narrowly separated ..... 11  
Preocular contacting nasal (abnormally narrowly separated), widely or narrowly separated from frontal ..... 12
- (11) Nuchal blotch more than 6 scales long; bands undulate in pattern, less than one scale wide at midbody ..... *fasciolata fasciolata*  
Nuchal blotch less than 6 scales long; bands reticulate in pattern, more than one scale wide at midbody ..... *fasciolata fasciata*
- (12) Body and tail banded ..... 13  
Body and tail not banded ..... *semifasciata incincta*
- (13) Apex of rostral not sharper than right-angle; midbody bands 5 or more times as wide as pale interspaces ..... *semifasciata approximans*  
Apex or rostral much sharper than right-angle; midbody bands 4 or fewer times as wide as pale interspaces ..... 14
- (14) Upper labials 5; nasal entire; primary and secondary temporals often fused ..... *semifasciata semifasciata*  
Upper labials normally 6; nasal semidivided; temporals seldom fused ..... *semifasciata roperi*

#### *Vermicella annulata multifasciata* (Longman)

*Furina multifasciata* Longman, 1915:30. Darwin, Northern Territory (G. F. Hill).

**Diagnosis.**—The species *V. annulata* (Gray) is recognised by its elongate body boldly banded with black and white. Present race distinguished from others by fusion of internasals with prefrontals; further distinguished from *V. a. annulata* by more numerous ventrals, and from *V. a. snelli* by narrower bands separated by narrower interspaces.

**Distribution.**—Far northwest of Northern Territory from Darwin southeast to Pine Creek, and far northeast of Western Australia at Turkey Creek.



**Description.**—Snout rounded in profile. Total length: males 316-535, females 317-423. Tail (% total length): males 5.1-6.9, females 4.1-5.0.

Rostral wider than high, apex reaching back 0.25-0.4 way to frontal. Internasals fused with prefrontals. Frontal 1.5-1.9 times as long as wide, 0.6-0.8 as long as parietals, and 1.5-2.2 as wide as supraoculars. Nasal a little higher than long, broadly contacting large preocular which is usually separated from frontal. Postoculars 2, lower smaller. Temporals usually 1 + 1 + 2, primary much the largest. Upper labials 6.

Scale rows 15, usually increasing on neck (usually to 17, occasionally 16), not reducing before vent. Ventrals: males 254-265, females 270-282. Subcaudals: males 20-24, females 18-20.

End of snout (i.e. upper surface of rostral) black. Head blotch black, beginning just before frontal and usually finishing just before end of parietals and extending down over last two labials to lips. Nuchal blotch black, 6-9 scales long and separated from parietals by  $\frac{1}{4}$ -1 vertebral scales. Back crossed by 46-74 black bands in males (54-83 in females), usually encircling body but apt to be narrower on sides and paler below, 2 $\frac{1}{4}$ -4 scales wide at midbody and separated by white interspaces  $\frac{3}{4}$ -1 $\frac{1}{2}$  scales wide. One specimen (R 10476) with bands broken underneath has midventral line of dark spots. Tail with 4-7 black rings. Prefrontal bar, occipital bar and throat white or pale brownish grey. Black markings fading to brown in alcohol.

**Remarks.**—For a photograph of holotype and drawings of its head, see Waite & Longman (1920).

**Material.**—**Western Australia:** Kimberley Division: NM D 4716 (Turkey Creek, 107 mi. S of Wyndham). **Northern Territory:** QM J 2019 (holotype), R 8687, R 10476, NTM 1078, NTM 2662 (Darwin); R 26225 (Parap, suburb of Darwin); R23205 (Harriet Creek, 16 mi. NE of Pine Creek).

**Vermicella annulata snelli** subsp. nov.

**Holotype.**—R 19203 in Western Australian Museum, an adult female collected by C. Snell early in 1963 at Mundiwindi, Western Australia, in 23° 51' S, 120° 09' E.

**Diagnosis.**—Distinguished from *V. a. multifasciata* by free internasals, and from *V. a. annulata* by more numerous ventrals (254-313, against 180-243).

**Distribution.**—Pilbara region of Western Australia, south to Hamersley Range and east to Marble bar and Mundiwindi; and Northern Territory at Roper River Mission and in southern highlands.

**Description.**—Total length: males 262-452, females 271-504. Tail (% total length): males 4.6-6.0, females 4.2-4.6.

Rostral wider than high, apex reaching back 0.3-0.45 way to frontal. Suture between internasals 0.3-0.8 times as long as suture between prefrontals. Frontal 1.5-2.3 times as long as wide, 0.6-0.9 as long as parietals, and 0.9-2.5 as wide as supraoculars. Nasal a little higher than long, broadly contacting preocular which is moderately or widely separated from frontal. Postoculars usually 2, lower smaller and occasionally fused to upper or to temporal. Temporals normally 1 + 1 + 2, primary much the largest and occasionally fused to fifth labial. Upper labials 6.

Scale rows 15, usually increasing on neck (usually to 17, occasionally 16 or 18), usually not reducing before vent. Ventrals: males 259-289, females 264-313. Subcaudals: males 20-26, females 17-21.

End of snout (i.e. internasals and upper surface of rostral) black. Head blotch black, beginning on or just before frontal, finishing about end of parietals, and extending down over last two labials to lips. Nuchal blotch black, 6-9 scales long, separated from parietals by  $\frac{1}{2}$ -2 vertebral scales. Back crossed by 34-66 black bands, usually encircling body, 3 $\frac{1}{4}$ -5 $\frac{1}{2}$  scales wide at midbody and separated by white interspaces 1 $\frac{1}{2}$ -3 scales wide. Specimens with incomplete bands may have a midventral line of dark spots interrupted opposite bands. Tail with 3-6 black rings.

**Geographic variation.**—The material comes from three widely disjunct regions. The Pilbara series is the most distinctive and is characterised by (1) high ventral counts (averaging 284 in males, and 305 in females); (2) strong rostral—it is almost as high as wide and its angular apex extends back at least  $\frac{2}{3}$  of way to frontal (in Northern Territory specimens the apex is rounded and extends back not more than  $\frac{1}{3}$  of way to frontal); and (3) large head blotch—it usually extends a little past end of parietals (whereas in the Territory it usually finishes a little before end of parietals) and in half of the series it extends forward along midline to snout patch. Within the Pilbara series, the Mt. Herbert and Tambrey specimens are notable for their numerous body bands, viz. 55 and 66, against 34-41 for all other specimens of the race.

The Roper River series is characterised by low ventral and subcaudal counts and narrow frontal. The Central Australian specimens are notable for their wide frontal, especially as compared with width of supraoculars.

**Remarks.**—This snake is named after Mr Charles Snell who donated the holotype to the Western Australian Museum and many other reptiles from the upper Ashburton, Ophthalmia Range and Mundiwindi district.

**Paratypes.**—**Western Australia.** North-West Division: R 439 (Marble Bar); R 20238 (Mt. Herbert, 40 mi. S of Roebourne); R 6745 (Tambrey); R 17122 (Wittenoom); R 19204 (Mundiwindi). **Northern Territory:** NM D 10072-4 (Roper River Mission); NTM 75, NTM 2577 (Alice Springs); NTM 76 (Hermannsburg).

**Vermicella bertholdi bertholdi** (Jan)

*E[laps] Bertholdi* Jan, 1858 : 518. "Ile Adélaïde (Australie méridionale)." [Nomen nudum.]

*Elaps Bertholdi* (Simoselaps) Jan, 1859 : 123.

No locality [= Perth, Western Australia].

*Furina robusta* De Vis, 1905 : 51. Coolgardie, Western Australia (R. L. Reid).

**Diagnosis.**—The species *V. bertholdi* is recognised by its yellow dorsum boldly banded with black. Present race distinguished by poorly defined occipital bar of black-edged, white-centred scales and by dark lines along throat and side of fore-neck (formed by darkening of lateral edges of scales).

**Distribution.**—Lower west coast and coastal plain of Western Australia from Gingin south to Bunbury, and in the interior from Marilla, Ullawarra and Mundiwindi south to Kojonup, Hyden and the Eastern Goldfields, east into western South Australia and extreme south of Northern Territory.



**Description.**—Snout depressed, angular in profile but not tipped with cutting edge. Total length: males 102-254, females 89-301. Tail (% total length): males 10.7-13.1, females 7.8-9.7.

Rostral much wider than high, apex obtuse and reaching back 0.2-0.4 way to frontal. Suture between internasals 0.6-1.8 times as long as suture between prefrontals. Frontal 1.7-2.5 times as long as wide, 0.6-0.8 as long as parietals, and 1.4-2.2 as wide as supraoculars. Nasal long and low, contacting preocular which is widely or narrowly separated from frontal. Postoculars 2, lower usually smaller. Temporals 1 + 1 + 2, primary descending well down between fifth and sixth labials but never entirely separating them; upper tertiary large, especially when fused to scale behind it. Upper labials 6.

Scale rows 15, nearly always increasing on neck (usually to 17, occasionally 16), and always reducing before vent (usually to 13, sometimes 11, 12 or 14). Ventrals: males 112-127, females 118-131. Subcaudals: males 19-25, females 15-20.

Head creamy or olive grey, anteriorly freckled with black, posteriorly blotched with black (mainly on parietals and temporals). Occipital bar  $\frac{1}{2}$ -3 vertebral scales wide; scales white, narrowly or widely edged with black; obscurely demarcated from parietal and nuchal blotches. Nuchal blotch black,  $4\frac{1}{2}$ -7 $\frac{1}{2}$  scales long, usually encircling neck but narrower underneath. Body with 15-25 black rings (except for an Ernabella female with 32), occasionally broken midventrally,  $1\frac{3}{4}$ -3 $\frac{3}{4}$  scales wide at midbody (narrower in males than females) and separated by yellow interspaces 2-4 $\frac{1}{2}$  scales wide (narrower in males than females). Tail with 3-6 black rings (more in males than females). Dorsal ground coloration yellow, the scales edged with orange-red (except on two rows next to ventrals). Throat olive grey, anteriorly freckled with black; posteriorly (as on side of fore-neck) scales laterally edged with dark brownish grey so as to form narrow longitudinal stripes. Occasional specimens have dark midventral blotches between annuli.

**Geographic variation.**—In spite of its very wide range and some gaps in its distribution, e.g. Darling Range, this race undergoes little geographic variation. Apart from local peculiarities (some of which are mentioned below), variation is restricted to a few weak clines. From southwest to north and east the following changes occur:

- (1) absolute size increases—maximum attained at Ernabella in far northeast,
- (2) relative length of tail increases,
- (3) ventrals increase—maximum attained at Ullawarra and Middalya in far northwest (males have 3-4 more than elsewhere),
- (4) subcaudals increase,
- (5) dorsal and caudal bands increase,
- (6) width of yellow space between black bands decreases.

Other clines change direction. Length of nuchal blotch, least at Moora and Watheroo, increases towards north and east, but in far northeast it is again small. Similarly, width of bands at first increases north and east from the coastal plain, but decreases in far northeast. This last factor, coupled with no. 6 above, has

the following consequence: all snakes from the Eastern and Murchison Goldfields and some from the far eastern Wheat Belt have the bands wider than the interspaces (which of course does not suffice for the recognition of "robusta").

The Ernabella (S.A.) and southern Wheat Belt (W.A.) populations have a high frequency of individuals with midventral blotches between annuli; it is strange that this trait should be commonest at the southwestern and north-eastern extremities of the taxon's range. The specimen from Ullawarra is notable for the extensive break in its body bands.

**Remarks.**—Jan & Sordelli's drawing of *Elaps bertholdi* clearly depicts a specimen of the present taxon. The type, according to Jan, had 114 ventrals and 22 subcaudals, which agrees closely with males from Perth. Indeed it is highly improbable that specimens of *V. b. bertholdi* were available in Jan's time from outside of Perth.

For corrections to the original description of *Furina robusta*, see Mack & Gunn (1953 : 66).

**Material.**—**Western Australia.** *North-West Division:* R 5041 (Marilla); NM R 11016, NM R 11216-7 (Middalya); R 25258 (21 mi. NNW of Ullawarra); R 12277 (Mundiwindi); R 24839 ("Carnarvon"); R 3326 (Londor); R 1422 (Mt. Magnet). *Eastern Division:* R 26412 (25 mi. SW of Wiluna); R 6430 (Gidgee, 35 mi. NNE of Sandstone); R 12402, R 14916 (Kathleen Valley); R 199, R 4311, R 22866 (Kalgoorlie); R 24023 (Dedari, W of Bullabulling); R 22658 (Southern Cross); R 26278-9 (Noongaar). *South-West Division:* R 26642 (22 mi. NE of Yuna); R 19185 (Mullewa); R 26335 (Greenough); R 1552 (Irwin); NM D 9838 (Mingenew); R 9341 (Arrino); R 25612 (Morawa); R 7278 (Caron); R 26404 (Bunjil); R 21875, R 26406 (Maya); R 25283 (15 mi. W of Watheroo); R 9261 (Dandaragan); R 19738-9 (Moora); R 19881 (Kalannie); R 24985 (Mollerin); R 6544 (Wialki); R 1505-6, R 6013 (Koorda); R 1299, R 21566 (Trayning); R 7855 (Mangowine); R 3877-8 (15 mi. N of Lake Brown); R 8581, R 18503, R 24865 (Merredin); R 13452, R 25085 (Kellerberrin); R 14140 (Tammin); R 644 (Beverley); R 2496 (Quairading); R 3390 (Kwolyin); R 5196 (Erikin); R 1157, R 25909 (Naremben); R 19882 (Corrigin); R 21467-8 (Tutanning Reserve); R 434, R 795, R 4656 (Pingelly); R 13032 (Popanyinning); R 4368-9 (Wandering); R 25976 (Crossman); R 4957 (East Wickepin); R 4320, R 19746, R 21565 (Kulin); R 3429 (King Rocks, 20 mi. ENE of Hyden); R 519-20 (Dulbinning, E of Narrogin); R 25607 (Dudin); R 5367 (Kukerin); R 46 (South Katanning); R 8457 (Gingin); 27 specimens from Perth and suburbs (from Marmion Beach, Tuart Hill and Bassendean south to South Fremantle and Mt. Pleasant); R 19496 (Naval Base); R 13803 (Armada); R 19824, R 21246, R 24908 (Mandurah); R 18604, R 22287 (Miami); R 15107 (Bunbury). *Eucla Division:* R 319 (Balladonia). **South Australia:** NM D 10899-10901 (Ernabella); NM D 1954-5 and 1958 (Oodnadatta); NM D 4661 (Ooldea); SAM R 4734 (The Twins HS); SAM R 2301 (Kingoonya); SAM R 1690 (Bookaloo); SAM R 2118 (Pygery); SAM R 3661 (Kyancutta). **Northern Territory:** R 24471 (Kulgera).



***Vermicella bertholdi littoralis* subsp. nov.**

**Holotype.**—R 12770 in Western Australian Museum, an adult male collected by Mr Ross Vollprecht on January 16, 1958, in coastal dunes 7 miles south of Geraldton, Western Australia, in 28° 52' S, 114° 38' E.

**Diagnosis.**—Distinguished from *V. b. bertholdi* by large primary temporal usually reaching lip, sharply defined white occipital bar, nuchal blotch 4 or fewer scales long, and absence or feeble development of dark lines along throat and side of fore-neck.

**Distribution.**—Mid-west coast of Western Australia from Point Cloates south to Jurien Bay, including Shark Bay islands (Bernier, Dorre and Faure) and Houtman Abrolhos (East and West Wallabi).

**Description.**—Total length: males 110-199, females 104-385. Tail (% total length): males 11.7-14.2, females 8.0-10.4.

Rostral much wider than high; apex obtusely angular, reaching back 0.3-0.45 way to frontal. Suture between internasals 0.7-1.8 times as long as suture between prefrontals. Frontal 1.45-1.9 times as long as wide, 0.45-0.7 as long as parietals (longer in males than females), and 1.4-2.4 as wide as supraoculars. Nasal contacting preocular which is narrowly separated from frontal. Postoculars 2, lower usually much smaller. Temporals 1 + 1 + 2, primary very large and usually contacting lip. Upper labials 6.

Scale rows 15, increasing on neck in 63% of specimens (to 16 or 17), and reducing to 13 before vent (except in R 4501). Ventrals: males 104-113, females 114-125. Subcaudals: males 20-23, females 16-21.

Head anteriorly freckled with black and posteriorly blotched with black (anterior margin of blotches irregular; posterior margin a sharp transverse line behind parietals). Occipital bar white, 1½-2 scales wide, sharply demarcated from head and nuchal blotches. Nuchal blotch black, 2½-4 scales long (shorter in males than females), usually broken underneath. Body with 16-34 black rings (some not extending to flanks), 1¼-2¾ scales wide at midbody (narrower in males than females) and separated by interspaces of 1¾-3½ scales (narrower in males than females). Tail with 4-8 black rings (more in males than females). Throat suffused with olive grey.

**Geographic variation.**—The material falls into two groups: a northern from Point Cloates to Shark Bay, and a southern from the Abrolhos to Jurien Bay. Northern snakes differ from southern in having

- (1) only 16-22 rings round body, against 24-34,
- (2) on average one less caudal ring,
- (3) longer nuchal blotch,
- (4) relatively longer tail,
- (5) fewer ventrals and subcaudals.

**Remarks.**—Generally *littoralis* forms a nice link between *b. bertholdi* and *b. anomala*. However it has peculiarities of its own, such as the very long parietals (compared to frontal) and the tendency for island females to attain great size (three of five specimens exceed 300 mm, and the longest is also extremely stout).

There is nowhere any indication of gene-flow between *littoralis* and nominate *bertholdi*, des-

pite the evident proximity of the two races at Greenough and Irwin. If they should prove to be sympatric, *littoralis* would have to be raised to a full species, and the way would be open to divide it into a northern and southern race.

**Paratypes.**—**Western Australia.** *North-West Division*: R 16885 (near Point Cloates); NM R 817 (Shark Bay). *Shark Bay islands*: R 20528-9, R 26732 (Bernier); R 26733 (Dorre); R 23636 (Faure). *Houtman Abrolhos*: R 398 (West Wallabi); R 4501 (East Wallabi). *South-West Division*: R 13317, R 13297, R 26297 (Geraldton); R 1687 (Irwin); R 15104, R 23317 (Green Head, 15 mi. N of Jurien Bay); R 13925 ("Medina"); SAM R 2771 ("Murchison Goldfields").

***Vermicella bertholdi anomala* (Sternfeld)**

*Rhynchelaps anomalus* Sternfeld, 1919: 77. Hermannsburg, Northern Territory (M. von Leonhardt).

*Melwardia minima* Worrell, 1960: 132. Broome, Western Australia (M. Ward).

**Diagnosis.**—Distinguished from all other races of *V. bertholdi* by 5 (rather than 6) upper labials and large, well-defined head blotch.

**Distribution.**—Northwest coast of Western Australia from Derby to Onslow, southeast through Great Sandy Desert to Central Australia.

**Description.**—Total length: males 186-206, females 96-206. Tail (% total length): males 12.1-13.2, females 9.2-10.4.

Rostral much wider than high; apex obtuse, reaching back 0.3-0.45 way to frontal. Suture between internasals 0.7-3.0 times as long as suture between prefrontals. Frontal with posterior angle very acute (sides tending to be concave), 1.4-2.0 times as long as wide, 0.6-0.8 as long as parietals, and 1.8-2.8 as wide as supraoculars. Nasal contacting preocular which is narrowly separated from frontal. Postoculars 2 or 1, lower much the smaller and occasionally fused to temporal. Temporals 1 + 1 + 2, primary much the largest and broadly contacting lip. Upper labials 5, last largest and widely separated from fourth.

Scale rows 15, increasing on neck to 16 or 17, and reducing before vent to 13. Ventrals: males 119-130, females 123-129. Subcaudals: males 23-27, females 17-21.

Head blotch black, reaching forward to about anterior edge of frontal and back to just beyond end of parietals, often continuous on midline with black patch on end of snout (rostral and internasals), and extending down on side of head to posterior labials and occasionally almost to middle of throat. Nuchal blotch black, 3¼-6¾ scales long, usually encircling neck, separated from head blotch by 1-4 vertebral scales. Body and tail normally banded with black. Dorsal bands 20-31, 1½-2¼ scales wide at midbody and separated by pale interspaces of 2¼-3¼ scales. Tail with 5-8 bands in males, 4-7 in females.

**Geographic variation.**—Ventral counts are highest in Central Australia, least in West Kimberley. Subcaudal counts are evidently lower in West Kimberley than in the Pilbara and Central Australia.

**Remarks.**—The holotype of *Melwardia minima* differs from neighbouring females of *V. b. anomala* only in coloration: no annuli, shorter nuchal blotch and wider occipital bar.



**Material.**—**Western Australia.** *Kimberley Division:* R 1393, R 13815 (Derby); AM R 16494 (holotype of *M. minima*), NM R 819 (Broome); R 3441 (Lagrange). *North-West Division:* R 5105 (De Grey); R 8272-3 (Onslow). *Eastern Division:* SAM R 1766 (Well 37, Canning Stock Route). **Northern Territory:** NTM 74, NTM 77, SAM R 1554, SAM R 2316 (2), SAM R 4792 (Hermannsburg); NTM 2028 (Kathleen Creek, George Gill Range); SAM R 1616 (Finke River).

***Vermicella calonotos* (Duméril, Bibron & Duméril)**

*Furina calonotos* Duméril, Bibron & Drumeril, 1854 : 1241. "Tasmanie" [in error for Perth, Western Australia].

**Diagnosis.**—Distinguished from other unbanded 15-scaled *Vermicella* by longitudinal stripe of black-edged, white-centred vertebral scales.

**Distribution.**—Western Australia: lower west coast and coastal plain from Lancelin south to Safety Bay, inland to Bullsbrook, Caversham, Riverton and East Rockingham; also east of Darling Range at York on the upper Avon.

**Description.**—Body and tail moderately slender. Head narrow. Snout produced beyond mouth but not tipped with cutting edge. Total length: males 162-260, females 124-284. Tail (% total length): males 13.3-15.4, females 10.1-12.6.

Rostral much wider than high, apex reaching back 0.3-0.45 way to frontal. Internasals markedly smaller than prefrontals (absent in one specimen through fusion partly to nasals and partly to prefrontals). Suture between internasals 0.55-1.2 times as long as suture between prefrontals. Suture between internasal and prefrontal transverse. Frontal 1.2-1.55 times as long as wide, 0.7-0.8 as long as parietals, and 2.5-3.6 as wide as supraoculars. Low posterior extension of nasal nearly always contacting preocular. Preocular contacting frontal (30% of specimens) or narrowly separated. Postoculars 2, lower smaller. Temporals basically 1 + 1 + 2, but primary and secondary fused in 80% of specimens to form narrow shield up to 3 times as long as high; occasionally upper tertiary fused to secondary or to lower tertiary. Upper labials 6, last much the longest. Scale rows 15, increasing on neck in 70% of specimens (to 16 or 17), and reducing immediately before vent in 20% of specimens (to 14, 13 or 12). Ventrals: males 126-139, females 130-143. Subcaudals: males 28-35, females 23-29.

End of snout black, i.e. whole of rostral, part of nasal (sometimes as far back as nostril) and up to half of internasals (backward extent greatest about common suture). Head blotch black, usually beginning slightly behind anterior edge of frontal and finishing slightly beyond parietals, and extending down on sides to below eye but not to lip. Nuchal blotch black, 2½-4½ scales long, separated from head blotch by 2-3 vertebral scales; occasional scales towards rear of blotch may be white-centred. Longitudinal stripe from nuchal blotch to end of tail, consisting of white-centred scales narrowly or broadly margined with black (margin thickest distally). Vertebral stripe varies in development: at one extreme it may encroach broadly on to paravertebral scales and have white centres of vertebrals almost obliterated by thick margining; at other extreme, stripe may be

faint and largely discontinuous (in which case, snake will superficially resemble some specimens of *V. bimaculata*). Remainder of upper surface creamy white, each scale margined narrowly or fairly broadly with salmon pink or orange-red.

**Geographic variation.**—The unique specimen from east of the Darling Range (R 7330) is peculiar in having 35 subcaudals, i.e. 2 more than any other male.

**Material.**—**Western Australia.** *South-West Division:* R 26721 (9 mi. NE of Lancelin); R 12605 (Lancelin); R 23827 (Yanchep Beach); R 20681 (Yanchep); R 13439 (Pearce); R 1307 (Wanneroo); 46 specimens from Perth and suburbs, from Sorrento, Mt. Yokine and Caversham south to Cottesloe, Applecross and Riverton; R 25065 (Woodman Point); R 12312 (Naval Base); R 9311 (East Rockingham); R 6888 (Safety Bay); R 7330 (York).

***Vermicella bimaculata* (Duméril, Bibron & Duméril)**

*Furina bi-maculata* Duméril, Bibron & Duméril, 1854 : 1240. "Tasmanie" [in error for Perth, Western Australia].

**Diagnosis.**—Distinguished from other unbanded, unstriped 15-scaled *Vermicella* by 5 upper labials, the last broadly contacting fourth.

**Distribution.**—Western Australia from Greenough, Yalgoo (*vide* Loveridge 1934 : 292) and Cue south to Bunbury, Williams and the Eastern Goldfields, thence east into western South Australia.

**Description.**—Body and tail slender in males, a little stouter in females. Snout produced well beyond mouth but not tipped with cutting edge. Total length: males 156-390, females 163-446. Tail (% total length): males 8.1-10.3, females 5.6-7.4.

Rostral as high as wide; apex obtuse or rectangular, reaching back 0.5-0.7 way to frontal. Internasals almost as large as prefrontals. Suture between internasals 0.4-2.3 times as long as suture between prefrontals. Suture between internasal and prefrontal slightly to moderately oblique. Frontal 1.0-1.6 times as long as wide, 0.6-0.85 as long as parietals, and 2.4-3.6 as wide as supraoculars. Nasal contacting preocular which is well separated from frontal. Postoculars 2, much smaller than preocular. Temporals basically 1 + 1 + 2, but primary and secondary fused in 92% of specimens to form narrow shield up to 4 times as long as high, and tertiaries usually fused to each other. Upper labials normally 5 (6 in R 5210), last almost as long as first four together.

Scale rows 15. Ventrals: males 176-212, females 197-228. Subcaudals: males 25-30, females 19-23.

Head blotch glossy brownish black, beginning just before or behind anterior edge of frontal, and finishing a little before or behind end of parietals. Nuchal blotch glossy brownish black, 3½-6½ scales long, separated from head blotch by 2½-4½ vertebral scales. Scales of back and tail pale reddish brown narrowly or broadly margined with dark reddish brown (margin broadest distally). A few specimens have trace of vertebral stripe owing to widening of dark margin on vertebral scales, especially on forebody and tail.

**Geographic variation.**—All but four of our specimens (individually described below) fall into one of two groups, the first occupying the



lower west coast and coastal plain from Green Head south to Bunbury, the other the far north and east (that is generally beyond the Wheat Belt). The latter differs from the coastal group in their

- (1) larger size: maximum length of males 390 (against 335 in coastal snakes), females 446 (against 422),
- (2) shorter tail: males 8.2-8.8% of total length, (against 8.4-10.3), females 5.6-6.2 (6.2-7.4),
- (3) more numerous ventrals: males 204-212 (176-192), females 218-228 (197-214),
- (4) scale rows not increasing on neck (increasing to 16 or 17 in 85% of specimens),
- (5) black spot on end of snout in all specimens (usually smaller when present, but absent in most coastal specimens),
- (6) head blotch larger: nearly always beginning before frontal and usually finishing behind parietals (nearly always beginning on or behind anterior edge of frontals and finishing before end of parietals),
- (7) nuchal blotch a little smaller:  $3\frac{1}{2}$ -5 scales long ( $4-6\frac{1}{4}$ ), and separated from head blotch by narrower space:  $2\frac{1}{4}$ -4 vertebrae ( $3-4\frac{1}{2}$ ),
- (8) dorsal coloration usually darker, owing to wider scale margins.

In the northwest there has evidently been no recent contact between the two groups, if two males said to come from Greenough really do so. They have 30-36 more ventrals than a male from Green Head (only 77 miles to south). Moreover each of these three specimens is typical of its group with respect to presence or absence of snout spot, extent of head blotch and number of scale rows on neck.

Further south and east, however, there is a broad zone in which individuals variously combine the characters of the two groups. The two specimens from in or near the northeastern Wheat Belt (R 7854, R 4890) agree with the inland group in their short tails and numerous ventrals, but both have 17 scale rows on the neck and the nuchal blotch as in coastal snakes. Moreover R 4890 has no snout spot.

The two other specimens that cannot be assigned to either group are more complex in their admixture of characters and have peculiarities of their own. The male from Wundowie resembles the inland group in its large size (336 mm), dark dorsal coloration (indeed it is darkest of all our *bimaculata*), head blotch extending beyond parietals, and 15 scale rows on neck; but it has only 189 ventrals, a relatively long tail (9.1%), no snout spot, and nuchal blotch 6 scales long. The male from Williams resembles coastal snakes in its pale coloration, extent of head blotch, and number of scale rows on neck (17); but it has 198 ventrals, tail rather short (8.6%), snout black-tipped, and nuchal blotch extremely short ( $3\frac{1}{2}$  scales).

It is significant that the character, small head blotch, finds its extreme expression in the very south of the coastal group's range, i.e. in our single specimen from Bunbury, which is also notable for its dusky throat.

**Remarks.**—At first sight it would appear that an inland race should be recognised, but certain

difficulties preclude their formal separation. First there is the practical task of allocating the four problematic specimens to one or another race. If they had come from a small area or narrow zone it perhaps would not matter much what was done with them, but in fact they jointly occupy a substantial part of the species' range. If races were recognised, one should be able to state unequivocally which of them occurred in, say, the Wheat Belt.

Then there is the theoretical question, are these really races or incipient races or merely the ends of various clines? If the two groups were really races one could dispose of the problematic specimens as hybrids, and indeed the Wundowie specimen and (to a lesser extent) the Williams specimen have in their hotpotch of characters every appearance of being hybrids. But the two other specimens are not so easily disposed of and seem rather to be genuine intergrades.

Despite the inadequacy of our sample, it is clear that we are not dealing here with clines of the sort we noticed in *V. b. bertholdi* and will observe again in *V. s. semifasciata*. Instead we seem to have character plateaux separated by steps. The trouble from the taxonomist's viewpoint is that the several steps are not geographically coincident. Number of ventrals, for example, increases sharply to the immediate east of the Darling Range. In contrast, extent of head blotch after increasing between Bunbury and Perth remains much the same for at least 150 miles to the northeast of Perth.

**Material.**—**Western Australia.** *North-West Division:* R 719 (Lakeside, 30 mi. SW of Cue). *Eastern Division:* R 4921 (Menzies); R 5210 (Bulong); R 4722 (Kurrawang, 8 mi. SW of Kalgoorlie). *South-West Division:* R 26333-4 (Greenough); R 4890 (Lake Moore, 60 mi. E of Wubin); R 7854 (Mangowine, near Nungarin); R 13885 (Wundowie); R 4708 (Williams); R 23318 (Green Head, 15 mi. N of Jurien Bay); 30 specimens from Perth and suburbs (from Sorrento and Bassendean south to East Fremantle and Kenwick); R 5204 (Gosnells); R 9155 (Bunbury). **South Australia:** SAM R 1791 (Ooldea); SAM R 2302 (Kalgoorlie).

#### ***Vermicella fasciolata fasciolata* (Günther)**

*Rhinelaps fasciolatus* Günther, 1872 : 34.  
Perth, Western Australia (F. H. du Boulay).

**Diagnosis.**—The species *V. fasciolata* is distinguished from other 17-scaled *Vermicella* by wide separation of nasal from preocular. Present race distinguished by long nuchal blotch and narrow, undulate bands.

**Distribution.**—Western Australia from Shark Bay and Wiluna south to Perth and Widgiemooltha and east to Laverton (i.e. between latitudes 26 and 33° S, and west of longitude 123° E).

**Description.**—Body moderately stout. Head broad and somewhat depressed. Snout obtuse in plan, acute in profile, extending well beyond mouth and tipped with moderately sharp cutting edge. Total length: males 139-349, females 156-390. Tail (% total length): males 11.0-13.5, females 7.4-9.1.

Rostral wider than high; apex angular, penetrating slightly or moderately deeply between internasals. Suture between internasals 0.8-4.0 times as long as suture between prefrontals.



Suture between internasal and prefrontal transverse or moderately oblique. Frontal 1.2-1.7 times as long as wide, 0.75-1.2 as long as parietals, and 2.1-3.5 as wide as supraoculars. Nasal widely separated from preocular which contacts frontal (68% of specimens) or is separated (but by never more than half its height). Postoculars 2 (65% of specimens) or 1 (when lower fused to temporal or fifth labial). Temporals normally 1 + 1 + 2, larger than in *V. semifasciata* and seldom fused (primary with secondary in one specimen, and upper with lower tertiary in five). Upper labials 6.

Scale rows 17, increasing on neck to 19 or 21, and nearly always reducing to 15 immediately before vent. Ventrals: males 140-157, females 155-172. Subcaudals: males 24-30, females 19-22.

Head blotch black, extending back to end of parietals or a little before end, and forward nearly to anterior edge of frontal and sometimes narrowly along snout. Nuchal blotch black, 7-15 scales long, either continuous on midline with head blotch or separated by up to 1½ vertebral scales. Back and tail reddish (sometimes greyish in juveniles) narrowly banded with black. Males with 54-83 bands across body and 9-17 across tail, females with 59-85 and 6-11. Bands increasingly broken posteriorly and tending to be merely transverse rows of black U-shaped marks; ½-1 scale wide at midbody, separated by interspaces of ½-2 scales. All black marks fading to dark brown in alcohol, and dorsal ground coloration to creamy white.

**Material.**—**Western Australia.** *North-West Division:* R 24094 (4 mi. E of Denham). *South-West Division:* R 26502 (22 mi. NE of Yuna); R 402 (Carnamah); R 5936-7 (Jurien Bay); R 23883 (Ledge Point); R 20580 (Regan's Ford, 20 mi. S of Dandaragan); R 16500 (Beacon); R 2864 (Bencubbin); R 4253 (Bullsbrook); R 5939 (Caversham); R 13468 (Morley Park); R 14244 (Double View); R 8389 (Mt. Hawthorn); R 7056 (North Perth); R 25985 (City Beach); R 1311 (North Lake, Melville). *Eastern Division:* R 6323 (Wiluna); R 1751 (Laverton); R 26643 (Widgiemooltha).

***Vermicella fasciolata fasciolata* Stirling & Zietz**

*Vermicella fasciolata* Stirling & Zietz, 1893 : 175.  
Near Barrow Range, Western Australia (Elder Expedition).

*Hornea pulchella* Lucas & Frost, 1896 : 150.  
Charlotte Waters, Northern Territory (W. B. Spencer).

**Diagnosis.**—Distinguished from *V. f. fasciolata* by smaller nuchal blotch and wider body bands (which are reticulate in pattern rather than undulate).

**Distribution.**—Far east of Western Australia near Warburton, Barrow and Rawlinson Ranges, thence east into far northwestern South Australia and extratropical Northern Territory.

**Description.**—Maximum length: males 215-310, females 213-340. Tail (% total length): males 12.2-15.3, females 7.7-9.2.

Rostral wider than high, apex reaching back 0.3-0.4 way to frontal. Suture between internasals 0.7-1.5 times as long as suture between prefrontals. Frontal 1.4-1.7 times as long as wide, 0.75-1.0 as long as parietals, and 1.8-2.8 as wide as supraoculars. Nasal widely separated from preocular which is moderately or narrowly separated from frontal. Postoculars 2.

Temporals 1 + 1 + 2, except in one specimen which has 3 tertiaries; another has upper tertiary fused to secondary. Upper labials 6.

Scale rows 17, increasing on neck to 19 or 21, reducing immediately before vent to 15. Ventrals: males 150-156, females 158-172. Subcaudals: males 24-29, females 17-21.

Nuchal blotch 3½-5¾ scales long, separated from head blotch by 1-2½ vertebral scales. Males with 50-60 bands across body and 11-14 across tail; females with 49-73 and 8-10. Bands consisting of pale-centred scales widely margined with black; 1¼-2 scales wide at midbody (wider in males than females), separated by interspaces of 1-1¾ scales. Dark marks fading to purple in alcohol and ground coloration to pale pinkish brown.

**Geographic variation.**—The Northern Territory specimens differ from the Western Australian in having a relatively shorter tail and on average two fewer subcaudals. Two of the three Territory specimens, including the type of *H. pulchella*, have the prefrontals longitudinally divided.

**Material.**—**Western Australia.** *Eastern Division:* SAM R 5295 (Giles, Rawlinson Range); R 17856, R 22019, R 22068, R 22083 (Warburton Range); SAM R 2935 (type of *V. fasciolata*). **Northern Territory:** NTM 73 (Alice Springs); NTM 3070 (Nummery, 110 mi. E of Alice Springs); NM D 11226 (type of *H. pulchella*). **South Australia:** SAM R 4801 (Musgrave Park HS.); SAM R 7588 (5 mi. N of Mt. Caroline, Musgrave Park).

***Vermicella semifasciata semifasciata* (Günther)**

*Brachyurophis semifasciata* Günther, 1863 : 21.  
"Baranquilla (New Granada)" [in error for Perth, Western Australia].  
*Pseudoelaps rhinostomus* Jan & Sordelli, 1873 : 6. Southwest Australia.

**Diagnosis.**—The species *V. semifasciata* is distinguished from other 17-scaled *Vermicella* by nasal contacting preocular, and from other 15-scaled species by prolonged, upturned snout with cutting edge. Present race distinguished from other banded races by 5 upper labials, entire nasal, frequent fusion of primary with secondary temporal, and bands a little narrower to moderately wider than interspaces.

**Distribution.**—The southwest of Western Australia from Hutt River, Canna and Paynes Find south to Safety Bay, Wickpin and Kulin; and in eastern interior at Kathleen Valley (north of which it intergrades with *V. s. approximans*), Cosmo Newbery and Warburton Range; thence east into extreme northwestern South Australia.

**Description.**—Snout very prominent, lower surface of rostral deflected 30-40° up from horizontal. Total length: males 115-302, females 129-353. Tail (% total length): males 8.6-11.2, females 6.0-8.0.

Rostral as high as wide; apex much sharper than right-angle, penetrating deeply between internasals, and reaching back ½-⅔ way to frontal (less in juveniles). Internasals about as large as prefrontals. Suture between internasals 0-2.5 times as long as suture between prefrontals. Suture between internasal and prefrontal oblique. Frontal 0.9-1.4 times as long as wide, 0.8-1.1 as long as parietals, and 2.0-3.6 as wide as supraoculars. Nasal entire, almost always contacting preocular which is widely separated



from frontal. Postoculars 2. Temporals basically 1 + 1 + 2, but most specimens have primary and secondary fused; rarer aberrations include fusion of tertiaries and of upper tertiary with secondary. Upper labials normally 5; two specimens have 4 through fusion of first partly with second and partly with rostral; one has 6 through division of last; and one has 7 through division of second and fourth.

Scale rows 17, increasing on neck to 19-21, reducing to 15 immediately before vent in half of specimens. Ventrals: males 147-172, females 155-188. Subcaudals: males 20-26, females 14-20.

Snout with or without dusky markings. Head blotch dark brown, usually beginning a little behind anterior edge of frontal, finishing at end of parietals or a little before, and extending broadly down to level of eyes and sometimes narrowly to lips. Nuchal blotch dark brown, 4-10 scales long, either continuous on midline with head blotch or separated by up to 3 vertebral scales. Back crossed by 40-70 bands, 1-3 scales wide at midbody and separated by interspaces of 1-2½ scales. Tail with 6-10 bands in males, 5-8 in females.

**Geographic variation.**—Although the apparently isolated northeastern population differs in several characters from west-coast snakes, nearly every gap is bridged by the Wheat Belt series, which in general is only a little more like the coastal snakes than the much more distant northeastern series. Apart from local irregularities, especially in the Darling Range, variation is clinal. Of the seven southwest-northeast clines set out below, those marked with an asterisk extend to the next race, *approximans*.

- (1) increasing size\*
- (2) decreasing relative length of tail
- (3) increasing number of ventrals\*
- (4) increasing number of subcaudals\*
- (5) increasing number of body bands
- (6) increasing width of bands\*
- (7) decreasing width of pale interspaces\*.

**Material.**—**Western Australia.** *North-West Division:* R 9157 (Paynes Find). *South-West Division:* R 26849 (Hutt River); R 4509-10 (East Chapman); R 25609 (13 mi. E of Canna); R 2311 (Gutha); R 19883 (Maya); R 2083 (Watheroo); R 6716, R 6955 (Dalwallinu); R 6107 (East Dalwallinu); R 21284 (Mollerin); R 4974, R 8077 (Moora); R 22366 (8 mi. E of Gillingarra); R 26484 (7 mi. N of New Norcia); R 6457 (Koorda); R 5731-2 (Mukinbudin); R 8998 (Bolgart); R 10672 (Dowerin); R 4229 (Wyalkatchem); R 25594 (9 mi. S of Trayning); R 7843 (Mangowine, near Nungarin); R 8582 (Merredin); R 634 (Baandee); R 10557 (York); R 1171 (Narembene); R 10256 (Kulin); R 7918 (Malyalling); R 22997-8 (North Bindoon); 16 specimens from Darling Range (from Red Hill and Woorooloo south to Kalamunda); R 15825 (6 mi. SE of Yanchep); R 21600 (Wanneroo); R 5915 (Upper Swan); 27 specimens from Perth and suburbs (from Scarborough, Morley and Midland Junction south to Subiaco, Como and Maddington); R 9474 (Gosnells); R 6096, R 6911 (Peel Estate); R 13543 (Safety Bay). *Eastern Division:* R 16524 (20 mi. E of Warburton Mission); R 14660, R 15160, R 22017-8, R 22067, R 22075-9, R 22188-9 (Warburton Mission); R 13854, R 15102-3 (Cosmo Newbery); R 24917 (Kathleen Valley); R 21649 (40 mi. E of Southern Cross); R 5686 (Yellowdine); R

2262 (Marvel Loch); R 5208 (South Walgoolan). **South Australia:** SAM R 5358 (Mt. Davies, Tomkinson Range).

### *Vermicella semifasciata approximans* (Glauert)

*Rhynchoelaps approximans* Glauert, 1954 : 85.  
Muccan, Western Australia (D. W. H. Shilling).

**Diagnosis.**—Distinguished from other races of *V. semifasciata* by weaker snout, less oblique internasal-prefrontal suture, and extremely broad bands separated by extremely narrow interspaces. Further distinguished from *V. s. semifasciata* by 6 (rather than 5) upper labials.

**Distribution.**—Western arid zone of Western Australia from the De Grey River south and east to Lake Nabberu (south of which it intergrades with nominate race).

**Description.**—Snout not so prominent as in other races; lower surface of rostral deflected 20-40° up from horizontal. Total length: males 122-362, female 122. Tail (% total length): males 8.9-10.0, female 7.0.

Rostral wider than high; apex rectangular or slightly obtuse, penetrating moderately between internasals, and reaching back 0.4-0.5 way to frontal. Internasals considerably smaller than prefrontals. Suture between internasals 0.3-1.5 times as long as suture between prefrontals. Suture between internasal and prefrontal transverse or slightly oblique. Frontal 1.1 times as long as wide, 0.8-0.95 as long as parietals, and 2.2-4.0 as wide as supraoculars. Nasal entire or weakly grooved (from nostril to labial), contacting preocular which is separated from frontal. Postoculars 2. Temporals 1 + 1 + 2. Upper labials 6.

Scale rows 17, increasing on neck to 19, reducing immediately before vent in one specimen (to 16). Ventrals: males 169-181, female 176. Subcaudals: males 24-28, female 21.

Head blotch extending from about middle of prefrontals nearly to end of parietals and down on sides to level of eye. Nuchal blotch 5-8 scales long, either continuous on midline with head blotch or separated by up to 1½ vertebral scales. Back crossed by 45-68 dark bands, 2½-3½ scales wide at midbody and separated by pale interspaces ½-¾ scale wide. Males with 8-14 bands on tail. Dark markings fading in alcohol to dark, slightly reddish brown, and spaces between bands to brownish white.

**Geographic variation.**—The specimen from Wiluna agrees in coloration and number of labials with *approximans* (which at Windich Spring occurs only 80 miles to NNE). In rostral development and obliquity of internasals it is more like nominate *semifasciata* (which at Kathleen Valley occurs only 60 miles to south).

**Remarks.**—Probably owing to faulty redescription (Glauert 1957 : 43), *approximans* has been wrongly associated with *V. fasciolata*. That it is nothing more than a race of *V. semifasciata* is demonstrated by the intermediacy of the Wiluna specimen and the fact that *approximans* constitutes the extreme expression of five out of the seven clines observed in nominate *semifasciata*. Moreover, *approximans* is not very different from *V. s. roperi*, which likewise has 6 upper labials, unfused temporals and a tendency for bands to be much wider than pale interspaces.



The coordinates of the type-locality are 20° 38' S, 120° 03' E, not as given by Glauert.

**Material.**—**Western Australia.** *North-West Division*: R 5375 (De Grey, 37 mi. ENE of Port Hedland); SAM R 3469 (Pilgangoora, 55 mi. SSE of Port Hedland); R 10768 (Muccan, 42 mi. NNE of Marble Bar); NM R 725 (Marble Bar). *Eastern Division*: R 26848 (Windich Spring, Canning Stock Route, north of Lake Nabberu); R 6324 (Wiluna).

***Vermicella semifasciata roperi* (Kinghorn)**

*Rhynchoelaps roperi* Kinghorn, 1931 : 267. Roper River, Northern Territory (K. Langford Smith).

*Rhynchoelaps smithii* Kinghorn, 1931 : 267, in caption for Fig. 1 (of *Rhynchoelaps roperi*).

**Diagnosis.**—Distinguished from *V. s. approximans* by its larger, sharper and more strongly upturned snout and narrower bands separated by wider interspaces.

**Distribution.**—Kimberley Division of Western Australia and Northern Territory from Roper River south to Hatches Creek.

**Description.**—Snout very prominent; lower surface of rostral sloping 30–50° up from horizontal; tipped with sharp vertical flange; sides tending to slope up to a midrostral keel. Total length: males 142–350, females 132–368. Tail (% total length): males 8.2–10.7, females 5.5–8.5.

Rostral about as high as wide; apex much sharper than right-angle, penetrating deeply between internasals, and reaching back 0.4–0.7 way to frontal. Suture between internasals 0.5–2.5 times as long as suture between prefrontals. Suture between internasal and prefrontal moderately to sharply oblique. Frontal 1.0–1.3 times as long as wide, 0.8–1.2 as long as parietals, and 2.1–3.5 as wide as supraoculars. Nasal semidivided (by suture descending from nostril). Preocular contacting nasal but separated from frontal. Postoculars normally 2. Temporals normally 1 + 1 + 2; primary and secondary fused in R 20349; tertiaries fused in R 17127; and secondary longitudinally divided in R 21506. Upper labials normally 6 (5 in R 21500 and on one side of type).

Scale rows 15 or 17, usually increasing by 2 on neck, seldom reducing before vent. Ventrals: males 150–171, females 158–179. Subcaudals: males 20–24, females 15–20. Head blotch beginning either on rostral, internasals, prefrontals or just behind anterior edge of frontals and extending back to about end of parietals and on sides to at least level of eye and often narrowly to lip. Nuchal blotch 3½–9 scales long, either continuous on midline with head blotch or separated by up to 3½ vertebral scales. Back crossed by 34–63 bands, 1¼–3 scales wide at mid-body and separated by interspaces of ½–1¼ scales (at narrowest extreme, interspaces may be merely transverse rows of pale spots). Tail with 5–11 bands in males, 4–8 in females. All dark markings fading in alcohol to reddish or olive brown.

**Geographic variation.**—The material comes from three regions: Roper River, Kimberley and Tennant Creek. Taken in that order, and ignoring differences in longitude, we find the following north-south trends:

- (1) decreasing relative length of tail,
- (2) increasing number of ventrals,
- (3) increasing number of scale rows (invari-

ably 15 at Roper River, usually 17 in Kimberley, invariably 17 at Tennant Creek),

- (4) increasing number of body bands,
- (5) decreasing space between bands,
- (6) decreasing space between head and nuchal blotches,
- (7) frontal becoming shorter and wider.

Other regional variations are non-clinal, e.g. the low subcaudal counts at Tennant Creek (about 2 less than elsewhere), and the smaller and less upturned rostral at Roper River.

**Remarks.**—From a purely morphological viewpoint, *roperi* is scarcely worthy of separation from the nominate race. The specimen from Tennant Creek with 5 upper labials would probably pass unnoticed in a batch of *V. s. semifasciata*.

From an evolutionary viewpoint, there is more justification for recognising *roperi*. Whereas five of the seven clines observed in the nominate race extend to the superficially very different *V. s. approximans*, few if any extend to the superficially similar *V. s. roperi*. Moreover, the direction of clines 2, 3, 5 and 7 in *s. semifasciata* are reversed in *s. roperi*. A curious effect of these reversals is that relative tail-length, number of ventrals and subcaudals etc. at Roper River are nearer to those at Perth than in any intermediate region.

The occurrence of *V. s. roperi* at Charlotte Waters in the extreme south of the Northern Territory requires confirmation, for in the country to its immediate north only *V. s. incincta* has been collected. On the other hand, the Charlotte Waters specimen is very like females of the northeastern population of *V. s. semifasciata* and differs from them only in having 6 upper labials and a semidivided nasal.

**Material.**—**Western Australia.** *Kimberley Division*: SAM R 7914 (Wyndham); R 11975 (Kimberley Research Station, Ord River); R 17127 (King Leopold Range); R 13823, R 14187, R 20349 (Derby); R 13822 (4 mi. E of Derby); R 26701–2 (no precise locality). **Northern Territory**: AM R 9930 (holotype); NM D 9834, NM D 10057–8, NM D 10961 (Roper River Mission); R 21505 (Peko, 5 mi. E of Tennant Creek); R 21506–9 (Tennant Creek district); SAM R 2278 (Tennant Creek); SAM R 3634 (Hatches Creek); NM R 11329 (“Charlotte Waters”).

***Vermicella semifasciata incincta* subsp. nov.**

**Holotype.**—R 26844 in Western Australian Museum, an adult male collected on October 16, 1964, by K. R. Slater near Alice Springs, Northern Territory, in 23° 46' S, 133° 53' E. Formerly NTM 2301 in the collection of the Animal Industry Branch, Northern Territory Administration, Alice Springs.

**Diagnosis.**—Distinguished from all other races of *V. semifasciata* by absence of dark bands on body and tail.

**Distribution.**—Southern interior of Northern Territory from Mt. Denison south and east to Alice Springs.

**Description.**—Snout greatly prolonged past mouth; lower surface of rostral deflected 15–35° up from horizontal; tipped with sharp cutting edge. Total length: males 261–292, female 145. Tail (% total length): males 9.1–11.1, female 8.0.



TABLE 1

Mean total length (mm.), tail length (% total length), and number of ventrals and subcaudals in males (with female data in brackets).

	sample size	length	tail	ventrals	subcaudals
annulata snelli (1) ....	2 (3)	365 (435)	4.8 (4.2)	284 (305)	23.0 (20.7)
" " (2) ....	3 (2)	374 (348)	5.4 (4.6)	267 (270)	22.3 (18.5)
annulata multifasciata ....	5 (3)	389 (366)	5.6 (4.5)	259 (277)	21.8 (18.7)
bertholdi bertholdi (3) ....	21 (15)	183 (185)	11.6 (8.8)	116 (121)	21.7 (17.3)
" " (4) ....	26 (28)	174 (185)	11.7 (8.7)	116 (123)	22.2 (17.4)
" " (5) ....	16 (16)	201 (235)	12.3 (9.0)	123 (129)	23.7 (17.9)
bertholdi littoralis (6) ....	5 (6)	151 (223)	12.0 (9.1)	113 (120)	22.6 (17.8)
" " (7) ....	3 (4)	171 (252)	13.1 (9.0)	108 (119)	21.0 (17.7)
bertholdi anomala ....	4 (6)	193 (178)	12.8 (9.6)	125 (126)	25.6 (19.0)
calonotos ....	23 (32)	227 (239)	14.2 (11.4)	133 (140)	30.6 (26.0)
bimaculata (3) ....	16 (15)	251 (315)	9.4 (6.8)	185 (205)	27.9 (21.1)
" (5) ....	4 (4)	281 (375)	8.4 (5.9)	206 (223)	27.5 (20.0)
fasciolata fasciolata ....	14 (7)	271 (285)	11.8 (8.3)	148 (163)	26.6 (20.6)
fasciolata fasciata ....	6 (4)	268 (299)	13.5 (8.4)	152 (164)	26.3 (19.4)
semifasciata semifasciata (3) ....	16 (15)	219 (244)	10.1 (7.3)	156 (165)	22.6 (17.5)
" " (8) ....	9 (8)	231 (230)	10.0 (6.9)	156 (168)	22.7 (16.7)
" " (4) ....	12 (18)	217 (265)	10.0 (7.0)	163 (170)	23.4 (17.4)
" " (9) ....	5 (13)	251 (285)	9.5 (6.8)	166 (178)	24.0 (18.0)
semifasciata approximans ....	6 (1)	249 (122)	9.5 (7.0)	175 (176)	25.8 (21.0)
semifasciata roperi (10) ....	5 (2)	246 (266)	8.9 (5.9)	165 (178)	20.4 (15.5)
" (11) ....	6 (2)	274 (306)	9.7 (7.3)	156 (168)	22.5 (18.0)
" (12) ....	1 (4)	281 (243)	10.1 (8.1)	150 (161)	22.0 (18.3)
semifasciata incincta ....	3 (1)	236 (122)	10.1 (8.0)	153 (157)	22.7 (20.0)

(1) Pilbara, (2) Northern Territory, (3) Swan Coastal Plain, (4) Wheat Belt, (5) north and east, (6) south, (7) north, (8) Darling Range, (9) northeast, (10) Tennant Creek, (11) Kimberley, (12) Roper River.

Rostral about as high as wide; apex considerably sharper than right-angle penetrating deeply between internasals (completely separating them in NTM 2262), and reaching back 0.55-0.6 way to frontal. Suture between internasals (when present) 0.5-1.1 times as long as suture between prefrontals. Suture between internasal and prefrontal oblique. Prefrontals longitudinally divided in NTM 2262. Frontal 0.9-1.2 times as long as wide, 0.8-1.0 as long as parietals, and 2.2-3.0 as wide as supraoculars. Nasal entire or grooved (from nostril down to labial), contacting preocular which is separated from frontal. Postoculars 2. Temporals basically 1 + 1 + 2; no fusion, but primary divided in NTM 2263. Upper labials 6.

Scale rows 17, increasing on neck to 19; no reduction before vent. Ventrals: males 146-161, female 157. Subcaudals: males 22-24, female 20.

Head blotch blackish brown, beginning just in front of eyes and extending back nearly to end of parietals and on to side of head but not to lip; anterior margin arched back on midline. Nuchal blotch blackish brown,  $4\frac{1}{2}$ -5 scales long, separated from head blotch by 4-5 vertebral scales. Upper surface of rostral greyish brown. Back and tail unbanded; scales pale, narrowly margined darker.

**Geographic variation.**—The Mt. Denison snakes differ from the Alice Springs snakes as follows:—

- (1) dorsal and supracaudal scales pale reddish brown, edged with dark reddish brown (at Alice Springs the scales are whitish or pale grey and edged with blackish brown),
- (2) relatively shorter tail,
- (3) more ventrals,
- (4) fewer subcaudals.

**Remarks.**—In certain respects *incincta* is more like the eastern race, *V. s. australis* (Kreff), than any of the western races of *V. semifasciata*. It shares with *australis* low number of ventrals and wide separation of head and nuchal

blotches; and its complete lack of bands is foreshadowed by their extreme narrowness in *australis*.

Mr. K. R. Slater kindly donated the holotype to the Western Australian Museum.

**Paratypes.**—**Northern Territory:** NTM 2262-3 (Mt. Denison, 160 mi. NW of Alice Springs); NTM 63 (Alice Springs).

#### Discussion

Three things point to *Vermicella* being an old and declining genus: its lack of young species, the concentration of species in the southwest of the continent, and the disappearance of links with other genera.

By a young species I mean one which has so recently attained species status that it is still possible to say where it evolved and from what. A typical situation is where two closely related forms are mainly allopatric but have a small zone of overlap. There is nothing like this in *Vermicella*: sympatries are generally broad, and no two species are so close that one could postulate the characters of their common ancestor. Some species, like *bertholdi*, have had time to evolve very distinctive subspecies; others, like *calonotos*, to judge from their shrinking range, must be on the verge of extinction.

Five of the seven species occur in the vicinity of Perth, a locality notable for such reptilian relicts as *Pseudemydura* and *Pletholax*. In contrast, over most of northern and eastern Australia there are only two species, *annulata* and *semifasciata*. These species, it will be noticed, constitute the adaptive extremes of the genus.

It seems, then, that *Vermicella* has had to break new ground to survive in a region that is open to invasion by modern reptiles from the north.

Even though our knowledge of the comparative anatomy of Australo-Papuan Elapidae is very sketchy, I think one can safely say that *Vermicella* has no close relatives among living snakes. Not knowing whether *Vermicella* is derived from a fossorial stock or from more



TABLE 2

Mean width (in vertebral scales) of occipital bar, nuchal blotch and midbody bands and interspaces, and mean number of bands (dorsal + caudal).

	width of				number of bands
	occipital bar	nuchal blotch	bands	interspaces	
annulata snelli (1) ....	1.1	7.0	4.7	1.9	52
" " (2) ....	1.6	8.0	5.0	2.5	39
annulata multifasciata ....	0.8	7.6	3.3	1.1	67
bertholdi bertholdi (3) ....	1.3	6.0	2.4	2.9	24
" " (4) ....	1.4	6.4	2.6	2.7	23
" " (5) ....	1.7	6.1	2.5	2.8	26
bertholdi littoralis (6) ....	1.7	3.0	1.7	2.3	37
" " (7) ....	1.6	3.8	2.2	2.8	24
bertholdi anomala ....	1.9	5.8	1.8	2.7	31*
calonotos ....	2.5	3.7	....	....	....
bimaculata (3) ....	3.3	4.8	....	....	....
" (5) ....	3.2	4.2	....	....	....
fasciolata fasciolata ....	0.7	9.8	0.8	1.3	76
fasciolata fasciata ....	1.7	4.6	1.6	1.5	70
semifasciata semifasciata (3) ....	1.6	5.9	1.4	1.6	59
" " (8) ....	1.1	5.8	1.8	1.5	58
" " (4) ....	1.9	5.7	1.7	1.6	63
" " (9) ....	1.5	6.1	2.0	1.5	67
semifasciata approximans ....	0.9	6.7	2.8	0.6	69
semifasciata roperi (10) ....	0.6	4.6	1.9	0.9	64
" " (11) ....	1.3	5.9	2.2	1.3	57
" " (12) ....	2.3	6.6	2.1	1.5	45
semifasciata incincta ....	4.5	4.9	....	....	....

\* Excluding type of *Melwardia minima*.

(1) Pilbara, (2) Northern Territory, (3) Swan Coastal Plain, (4) Wheat Belt, (5) north and east, (6) south, (7) north, (8) Darling Range, (9) northeast, (10) Tennant Creek, (11) Kimberley, (12) Roper River.

generalised elapids, we are also ignorant as to which of its characters are primitive and which are specialised. We must therefore content ourselves with a brief survey of the extant species.

Table 1 reveals considerable correlation between number of ventrals, total length and (inversely) relative length of tail. Most taxa have an average length of between 20 and 30 cm. In *V. bimaculata* and still more clearly in *V. annulata*, increase in size has been effected by elongation of the trunk. Conversely the small size of *V. bertholdi* has resulted from shortening of the trunk. Now *bertholdi* and *annulata* comprise a group somewhat apart from the other species of *Vermicella*. Consequently the degree of elongation can have no phylogenetic significance in this genus.

Nor does absence of bands provide a clue to phylogeny, for their loss in the race *incincta* of *V. semifasciata* and in the variant "*minima*" of *V. bertholdi anomala* seems to have been recent and sudden events. Moreover, consideration of the sequence *bimaculata-fasciolata-semifasciata* suggests how lost bands could be reacquired. In the unbanded *bimaculata* all the dorsal scales have dark margins which are thickest at their free edges. Single transverse rows of such scales are virtually all that constitute the bands of *V. f. fasciolata*. When the margin is more uniform in width and the adjacent scale-rows become involved, we have the narrow, reticulate bands of *V. fasciolata fasciata* and *V. semifasciata australis*. Increasing encroachment of the dark margins on the pale centres of the scales and increasing involvement of neighbouring scale-rows would lead first to the solid but still narrow bands of Swan River *V. s. semifasciata* and finally to the extremely broad bands of *V. s. approximans*.

Instead of crossbands, *V. calonotos* has a vertebral stripe, but the scales composing the stripe are precisely like those of the taxa with reticulate bands. Evolution of the stripe (incipient in individual variants of *V. bimaculata*)

can be imagined as taking place in two steps. At first the wide-margined scales are confined to those dorsal and caudal segments having a potential for band-formation. Then, by a process not different from what must have occurred in the taxa with broad bands, the margined scales invade the interannular zones till the stripe is continuous.

"Segments having a potential for band-formation" implies that, though bands may be lost, the faculty for forming them in definite sites is retained. This belief is based on (1) the persistence in all taxa of a nuchal blotch, (2) the presence in most taxa of a head blotch, (3) the prevailing constancy among taxa of the position of these blotches, and (4) the evident homology of these blotches with the caudal and dorsal bands.

From the first two columns in Table 2 it will be seen that the nuchal blotch, though varying much in extent, is centred in nearly all taxa on the fourth or fifth vertebral scale. Similarly the head blotch tends to be centred midway between the anterior edge of the frontal and the posterior edge of the parietals (so that whenever the blotch fails to reach back to the end of the parietals, it usually fails also to reach forward to the prefrontals).

That the blotches and bands are serially homologous is indicated by (1) their generally identical coloration within a taxon, (2) the fact that the head and nuchal blotches extend to the lower surface only in the taxa whose bands do likewise, (3) the presence in the nuchal blotch of some individuals of *V. calonotos* of white-centred scales like those of the vertebral stripe, and (4) the similarity in many taxa between the nuchal blotch and the anteriormost dorsal bands with respect to extent and interspacing.

The sequence *bimaculata-fasciolata-semifasciata* is also one of increasing rostral development. The snout is produced well past the mouth in *bimaculata* but lacks a cutting-edge. In *fasciolata* we see the beginnings of the cut-



TABLE 3

Mean ratio between (1) length of rostral and distance from tip of snout to frontal, (2) length of suture between internasals and that between prefrontals, (3) length of frontal and its width, (4) width of frontal and width of supraocular, and (5) length of parietal and length of frontal.

	rostral	internasal	frontal length	frontal width	parietal
<i>annulata snelli</i> .....	0.38	0.6	1.7	1.7	1.4
<i>annulata multifasciata</i> .....	0.34	....	1.7	1.9	1.4
<i>bertholdi bertholdi</i> .....	0.34	1.0	2.0	1.8	1.4
<i>bertholdi littoralis</i> .....	0.36	1.1	1.7	1.9	1.7
<i>bertholdi anomala</i> .....	0.38	1.2	1.7	2.2	1.3
<i>calonotos</i> .....	0.35	0.8	1.3	3.0	1.3
<i>bimaculata</i> .....	0.60	1.0	1.2	2.9	1.4
<i>fasciolata fasciolata</i> .....	0.41	1.4	1.5	2.5	1.1
<i>fasciolata fasciata</i> .....	0.34	1.0	1.5	2.3	1.1
<i>semifasciata semifasciata</i> .....	0.58	0.7	1.2	2.8	1.1
<i>semifasciata approximans</i> .....	0.47	0.9	1.1	2.7	1.1
<i>semifasciata roperi</i> .....	0.53	1.0	1.1	2.7	1.0
<i>semifasciata incincta</i> .....	0.56	0.6	1.1	2.5	1.1

ting-edge which is such a prominent feature of *semifasciata*. Associated with this trend are those of increasing obliquity of the anterior head-shields (internasals and prefrontals) and of increased shortening and widening of the posterior shields (frontal and parietals).

Fusion of head scales is common in *Vermicella*; but the precise nature of the fusions, like the details of habitus, coloration and rostral development, throws little light on the phylogeny of the species. The nominate race of *V. semifasciata* shares with *V. bimaculata* high frequency of fusion between the last two labials and between the primary and secondary temporals; yet in other western races of *semifasciata* both of these fusions are rare. In the nominate race of *V. fasciolata* fusion is moderately common between the tertiary temporals, and the lower postocular is often fused to a neighbouring scale; such fusions, however, are unknown in the northeastern race, *fasciata*, but recur in several other species. Fusion of internasals with prefrontals is diagnostic of *V. annulata multifasciata*; in *V. calonotos* it is a rare aberration. Though all these modes of fusion (and the much rarer fissions) are too irregularly distributed to reveal relationships, the very fact that they are limited in kind and may crop up anywhere in the genus reinforces the belief that this assemblage of species is a natural one.

Finally we may recapitulate the principal trends in *Vermicella*. First we have the annulate spaces, *bertholdi* and *annulata*, which are further characterised by a deep primary temporal and relatively long and narrow frontal and parietals. *V. bertholdi* has become adapted for burrowing in sand; its body is short and its snout flat and sharp in profile (like that of its scincid analogue, *Rhodona*). *V. annulata* has become adapted for an active, nocturnal way of life; its body is elongate, the snout rounded in profile and relatively high, and all lipochromes have been lost (in contrast to *bertholdi* whose only white interannular zone is that between the head and nuchal blotches).

The other sequence of species, *calonotos* to *semifasciata*, is non-annulate or even unbanded. Their frontal is relatively short and wide, the anterior temporal long and low, and the last labial very much larger than the others. Fusion is common between temporals. The parietals are generally short and the rostral strongly developed. Only one of the species, *semifasciata*, is widespread, and it is this species that is most

specialised for burrowing in heavy soils. The other species are fossorial in a more generalised way and are probably yielding ground to the lygosomatine skinks.

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